ON THE USE AND ABUSE OF REFUSE ORGANIC MATTER BY DIFFERENT MODES OF SEWERAGE.

By Thomas Hawksley, M.D., Lond.

THE matter of the globe essentially, is precisely what it was at the dawn of creation. The "elements" of which the various forms of material objects around us are composed, are in weight, quantity, and quality identically what they were at the beginning, and have been the same through every stage and period of geologic history. But a vast change has been steadily, and with increasingly rapid and extended strides, going on in the condition of that matter, in the arrangement and combination of those "elements." From the seething steam of a world of boiling waters and of molten rocks and metals, to the stage when the earth's hardened crust was bent and upheaved into its valleys and mountains, all was dead, and the "elements" were held in the lifeless bonds of *inorganic* existence. But from that period to the present the mysterious principle of life has animated them, and the creations of the vegetable and animal worlds have converted vast quantities of *inorganic* into *organic* matter. From humbler to higher forms the great change has been advancing, and with every step the pace quickens and the volume enlarges with a progression more like the geometrical than the arithmetical, so that now a generation may see the gathering multitude that teems and struggles for existence in places that a short time before were scarcely occupied. But, in direct proportion to the increase and amount of life and organization, comes the necessary attendant of cast-off and dead material. Some years ago it was computed that the quantity of human dry fœcal discharge in London amounted to 139 tons daily. About the same time 52,000 corpses were annually interred within the limits of the city. Add to this the débris of animals, vegetables, and food, and we can still form a very poor conception of the enormous amount of organic matter thrown loose in the busy hive of the community. Properly we take alarm if gunpowder be stored in magazines near us, but little do we heed the fact that organic matter, consisting as it does of the same elements as gunpowder, is just as dangerous in its own way as the latter, though its explosions are noiseless, and the ruin it works is not so directly seen.

Matter once raised to the organic form will not immediately fall back to the inorganic; it lingers in an intermediate state, in which it shows great affinities for re-union with life. Associated with vegetable life the union is a blessed one, and health and beauty the result; but getting access to animal life, disease is the consequence; the circle of re-union has been too short, the effete organic matter has not received the re-arrangement and the elevation necessary to fit it for its higher uses, a work which is so beautifully and vicariously effected for us by the vegetable creation.

Thus it is that one of the first and most important desiderata for man in community is perfecting the circle in the transmission of organic matter, from the vegetable to the animal, and from the latter back to the vegetable. This simple and obvious duty, how is it performed in the 19th century? a period the last fifty years of which have been truly remarkable for the extraordinary degree in which man has been permitted to obtain the government over matter and of material forces—steam, gas, electricity, light,—each has been drawn by ingenious intellects from its hiding place; each has become the potent slave of man; yet withal what have we done with our refuse organic matter? Paradox of humanity, we have successfully dealt with the most abstruse and difficult questions of intellect, science and art, but the first duty of domestic life we have left in the most primitive, and worse than primitive state: we have been acting like the foolish birds that foul their own nests. Dr. G. Moore writing on it says, "The Egyptians, Greeks and Romans learned to drain their towns, and to supply them with water for bathing, as well as for drinking, in a manner that puts to shame our boasted advancement in the arts of civilization; and the remains found in Mexico and Peru show that these ancient people enjoyed advantages of sewerage and water supply better than our own."

The art of drainage made a great retrogression when the practice was commenced of pouring *solid* matters into the sewers. This is essentially and altogether wrong in principle and practice, and no amount or extension of drains can ever rectify it. There must be always a large quantity of solid matter clinging to and accumulating in the sewers, undergoing decomposition and producing malaria, and the sewers must act like long chimneys, with a draught of air blowing constantly from the periphery to the centre, and conveying into every part of the town the malaria so cleverly engendered within, and which no amount of trapping can prevent. The longer the sewers, like chimneys, the stronger must be the draught; and the direction of the current must always be *to* the town, and not *from* it, because the town must be the highest and warmest extremity.

What do we find the result to be in London? What of the air?

> "It is not air, but floats a nauseous mass
> Of all obscene, corrupt, offensive things."

Dr. Gavin in his "Sanitary Ramblings" gives the following illustration. He says, "The patent manure manufactory is established next door to a bottle merchant, who complains that the putrid emanations adhere to the inside of his bottles, and spoil the wine that may be put into them, and consequently his trade will soon be ruined if the manure manufactory is not removed."

The purplish black colors that form on the white painted fronts of houses, what are they but demonstrations of the sulphuretted hydrogen in the air turning the lead of the paint into the black sulphuret? This change is especially seen near the opening of the sewers. Again, how much of the extraordinary low vitality character of disease in the present day is due to this cause? Dr. Copland, writing on this subject, says, "The effluvia or emanations from the sources pointed out are not always perceptible to persons who have become, by residence, accustomed to them, and their effects are hence often slowly and imperceptibly produced. In all members of a family, and more especially among the younger members, debility, in its numerous forms and consequences, is the soonest and most injuriously induced by these causes; occasioning numerous forms of visceral disease in some, and scrofula, consumption, and glandular obstructions in others, and *predisposing all to be seized by infectious, contagious, and epidemic maladies, whenever they are exposed to the poisonous emanations by which these maladies are propagated.* Each person infected by either of these maladies—whether continued fevers, scarlet fever, measles, small-pox, pestilential cholera, &c.—becomes a focus of infection to those surrounding him, if they are predisposed by the emanations proceeding from the sources now pointed out; or if he reside within the sphere of their influence. Even the clothes of persons embued by the infecting poison of either of these infectious maladies, will communicate it to those who have become predisposed by the causes now insisted upon—by the effluvia proceeding from drains, sewers, or foul reservoirs, from stagnant fetid pools, or other injurious exhalations."

This extract from Dr. Copland's Essay on the Drainage and Sewerage of London has been given because it outlines with so much perspicuity the injurious action of bad drainage. Debility and anœmia, exhibited often in pale waxen faces and transparent ears, is the common result: occasionally it is the direct vehicle of specific disease, especially when the excreta of those sick with specific diseases get access to drinking water, but more commonly, as Dr. Copland says, supplying the *predisposing* cause, so that the blood of any person charged with the impurities of bad drainage is *predisposed* and *ripe* to act with any of the poisons of specific disease which may chance to reach it. Within the last month an example of this came before the writer, one of the many that so often present themselves. In a family of five children, the two elder boys, aged eleven and nine years, amused themselves by breaking through the ice of a stagnant pond in the garden with sticks, and then stirred up the bottom. The elder of the two soon gave up the fun on account of a filthy odour, the other pursued it longer. Some days after, these two boys only, of the family, were stricken with diphtheria, and the one that stirred the pond most had the severest attack. The other children were not attacked, though all had been living under precisely the same circumstances, the pond business excepted. It is not presumed that the pond malaria caused the diphtheria, the cause of the latter was epidemic; but the facts seem fairly to warrant the belief that the pond malaria supplied the "tertium quid," which made the diptheritic epidemy effective.

What of the soil? It is black, greasy, with organic matter, and its springs contain nitrates and other results of putrid decay, and of direct communication with the sewers,—witness the outbreak of cholera in 1855, in Broad-street, Golden Square, so clearly traced by the late Dr. Snow to contamination of the pump water by an imperfect drain from one of the neighbouring houses. The Thames has made so strong an appeal to our eyes and noses that his complaints could not be overlooked; and the present extension of the Main Drainage System is due principally to that flagrant evil.

Actuated by the foregoing considerations, in 1857 the author sent the following letter to Sir Benjamin Hall, Bart, the then Commissioner of Works:—

THE SEWERAGE OF LONDON.

"26, George-street, Hanover-square, Jan., 1857.

"Sir,—I trust you will forgive me for troubling you with a communication the matter of which may appear to you crude, or to have been anticipated by others. My excuse is the great importance of the subject, and my own strong conviction of the truth of the opinions I hold concerning it. The subject alluded to is the 'Drainage of this Metropolis, and the economical application of the sewerage.'

My profession being that of 'medicine,' to shield myself against the charge of presumption in attempting to treat a great question of engineering, allow me to refer to the fact that he who has to study the great and perfect machinery of Nature may often from that storehouse of invention get a hint of the way to compass a difficulty which might otherwise remain undetermined. Nature has much of this kind of work to do for all animal bodies,—*i.e.*, the removal out of the living body of its refuse and effete particles. We find that she adopts one mode and principle of mechanism for the conveyance of the fluid excreta, and another kind and principle for that of the more solid excreta. For the first we find arranged a system of continuous tubes, analogous to our existing system of sewers, which, for distinction, I will beg to designate the principle of continuity; it is well exhibited in the urinary system of all animals. In the second case a system of instruments is employed comparatively small in size, but vast in number, each complete in itself, and independent of its neighbours, so that disorder and interruption in function of individual members does not interrupt the work and action of the general body. These little instruments in anatomy are called 'glands,' or 'glandules,' and I would distinguish the principle of their action as that of 'detail.'

It seems to me, Sir, that in this arrangement is indicated the only successful mode of accomplishing the essential *desiderata* of the sewerage question. The proposal to extend our present system, and to pollute our river some few miles from the metropolis, is surely a bungling expedient, independently of the atrocious waste of a great element of our national wealth. Another expedient, suggested by a most talented and illustrious member of my own profession, to employ a special system of tubes to convey the excreta free of the surface and waste water, would be found, I submit, full of impracticability, for the tubes must soon be hopelessly choked up.

The analogy of nature points out that we should adopt the double system of 'continuity' and of 'detail.' Our existing sewers afford a ready and inexpensive machinery for fulfilling the former object—that, namely, of carrying off from every part of the town into the river all the surface water, together with that from our cisterns, and the water, separated by a process to be explained, from the solid and fluid excreta received into our water-closets.

The second principle—that of detail—I would have employed by each house in the metropolis, by the use of an instrument analogous to Nature's gland, whereby all the refuse of the house might be separated into two parts, the one a comparatively pure and colourless water, which would flow off through our sewers as before mentioned, and the other a solid, deodorized, and fitted in every way to supply the place of foreign guano. Every house presents the necessary conditions in the possession of fire-ashes and of soot. The instrument referred to would in principle be constructed thus,—It should consist of a cast-iron box, of a convenient size and shape placed in the front or back area of each house. Its floor would communicate with the sewers by means of a suitable perforated plate and trap. It would also be provided with the means (air-tight) of introducing into it the fire-ashes and the soot, and for clearing out of it, at appropriate seasons, the whole contents. Its summit, or roof, should terminate in a cast-iron tube about six inches in diameter, which would ascend the side of the house perpendicularly, like the present rain-water pipe. Into it the water-closets of the house would eject, by a convenient arrangement, their receipts. The whole apparatus, by the expenditure of a little ingenuity, could be made very simple in construction, little liable to get out of repair, and perfectly air-tight as regards the possibility of ill odours or gases escaping.

A single tube outside the house could thus easily carry down to the deodorizing receptacle the contributions of the largest number of water-closets any house might possess. Its simplicity and strength would enable it to be easily and derfectly cleansed when necessary.

Before employment the floor of the receptacle would be covered by a sufficient layer of cinder dust, and, upon the latter, by another layer of soot. In action the fluid excreta from the water-closets would by percolating the soot and ash give up the greater part of their sensible qualities, and would escape into the sewers with very little power to contaminate our river, which objection would be removed by carrying the point or points of outlet into the river, some miles below the metropolis, this time, however, without objection from the inhabitants in the neighbourhood of the outlet. This great advantage to our sanitary reforms would result—that we could have no underground accumulations of putrefying matter. The solid excreta would mingle with the soot and ash, become deodorized and condensed, and form a very perfect and manageable manure—manageable, because in this form it would admit of such easy and expeditious removal by the scavengers, and without greater nuisance than the present mode of removing our dust. This portion of the business might be practised once a week, a fortnight, or a month, as experience would point out the expediency. For each house it would probably be executed in two minutes, and the carts as they were filled would be at once driven to the station for immediate transmission to the country.

My letter would be too long, did I attempt to combat the objections I foresee, but I believe I am prepared to reply to any, should you deem my communication worthy of discussion.

In conclusion, permit me to suggest that, in addition to the advantages which this plan offers, such as to health, the avoidance of underground accumulations, which poison our springs, and eventually our river; to agriculture, in the supply of a rich guano; to convenience and economy, in the employment of our existing drains and sewers, and in the addition of a mechanism simple, inexpensive, not liable to derangement, and involving important improvements in the dwellings of the poor; that the value of the manure will be equal to all the expense of maintaining our town in a state of sanitary sweetness and cleanliness.

I have the honour to be, Sir,
Your most obedient and humble Servant,
THOMAS HAWKSLEY."

"To Sir Benjamin Hall, Bart, M.P., &c.,
Chief Commissioner of Works."

Afterwards the author made some experiments on the subject, which were embodied in a paper in the *Sanitary Review* for March, 1857. The correspondence elicited by these communications brought to the knowledge of the writer the claims of Mr. Jasper W. Rogers, C.E., as the inventor of a somewhat similar method of drainage, which he said he submitted to the Metropolitan Commissioners of Sewers in 1849, and printed in the *Morning Herald* at the same time. On reference to that journal the writer found that Mr. Rogers' information was quite correct. The principal difference between the two plans appears to be, that in Mr. Rogers' method the filtering receptacles were to be cast-iron *movable* tanks, sunk in brick cells while in use, and to be lifted out by a crane and conveyed away for emptying and cleansing purposes. By the author's method a receptacle is built either of brick cemented and lined by cement, or of slates, or of stone, or of iron. It is to be placed outside the house, in the position most convenient to receive all the drainage of the house, or associated block of houses. At the side proximal to the house, and at top, the entrance-pipe is fixed and trapped. At the opposite side, near the bottom, the exit-pipe is fixed, which is intended to run into the ordinary sewer or drain-pipe. Within the receptacle is placed a filtering screen of gravel, made of two plates of perforated zinc, iron, or tile, separated about four inches apart, and the gravel placed between them. This screen is so placed as to prevent any but the perfectly fluid portion of the contents of the receptacle escaping into the exit-pipe. Into the receptacle is thrown, from time to time, portions of the best deodorant procurable, as, for instance, charcoal, soot, or fresh earth. The results of the operations of this machinery are, 1st.—The discharging out of the house all refuse organic matter, and enclosing it in an air-tight box, from which there can be no possible reflux or remora into the dwelling. 2nd.—The binding up and fixing of all volatile and offensive emanations from the organic matter so enclosed, by the use of the most suitable deodorants, and the precipitation of the organic elements of urine by the same. 3rd.—The separation by the filtering screen of the solid and valuable manure left in the receptacle, and the transmission of the clear and comparatively pure water *through* the screen, into the existing drains or sewers.

At convenient times the contents of these receptacles may be removed by spade and pail into suitable carts for transmission to the fields, without any nuisance or injury. On the other hand the "receptacle" becomes a source of profit instead of expense to the householder, with the satisfaction that his private benefit is now consistent with, and a part of the public good. The air, the springs, the rivers are no longer poisoned, and the earth rejoices in the recovery of its due, and brings forth her increase accordingly. With a population increasing so rapidly as it is in this country, and with so large a portion of it winning its bread, not with a fair return for the sweat of the brow as Providence intended, but with weakened emaciated frames and pallid faces, drudging the long day through amid foul air and dirty walls, that shut out the light of heaven and the face of nature; with such necessities for cheap and good food, it is a great individual and national sin to cast away the means of life, and in the same act literally spoil and poison the gifts of air and water that in a state of nature come to us free and pure.

From these arrangements, it is submitted that they afford a much simpler, and less expensive method than Mr. Rogers, for the latter requires double the machinery, viz.: filtering receptacle and a cell properly built to receive it; together with the time, complication, and expense of the removable connections by which the entrance and exit pipes have to be fitted each time a change is made.

Charcoal, and especially peat charcoal, is believed to be the best deodorizer, absorbing as it is said to do in Johnson's Encyclopœdia:

Ammoniacal gas	90	volumes.
Sulphuretted hydrogen	55	ditto.
Carbonic acid	35	ditto.
The bulk of charcoal being as......	1	ditto.

Where charcoal cannot be conveniently procured, fresh earth answers extremely well, and for cottage "receptacles" might be generally adopted.

To Mr. Jasper Rogers, society is under great obligations, both for his ingenious plans and suggestions for sewerage, and especially for the philosophical and persevering way in which he has worked out and brought to notice the extraordinary power of *peat* charcoal as a deodorant. Some years ago he kindly gave the writer the opportunity of testing it, on the occasion of an experimental "receptacle" built on the plan herein described, being filled by solid human manure after it had been in use about three months. Up to this time no deodorant had been applied and the mass when removed by spades from the "receptacle" was most overpoweringly disgusting. Mr. Rogers had about three bushels of peat charcoal thrown over it, and quickly spaded into it, and it is no exaggeration to say that *instantly all offensive odour was* *removed*, and in a few days the compost was a dry mass that was conveniently filled into bags and sent into the country.

The writer has thus attempted to draw attention to the powers, for good or evil, of the enormous accumulation of organic matter around us, and to show that there are means simple, effective, and inexpensive, of conveniently avoiding the evil effects, and of obtaining the good naturally belonging to it. It is sincerely believed the public might have been spared the great expense of the magnificent system, of high, middle, and low level sewers; for however perfect as conduits of water, they never can so remove the solid sewage as to save the town from the ill effects of entrusting solid organic matter to miles of underground tube shafts. We must still have as much, if not more, of sewer malaria. We must still have the same risks of saturated soil and poisoned water. We still continue to waste the food of plants, because though companies may be formed to employ the sewage as it escapes after its long journey through the sewers, it is collected at a time and stage when its best and most useful qualities have been washed out and evaporated. The proper time and stage to collect it is close to its source, and before its ammoniacal and phosphatic elements have been lost. Much it is to be regretted, that even in this great and free country, where our statesmen as a body are so patriotic, independent, and enlightened; that often the right and best measure fails to be carried, in consequence of a majority being bound by some great opposing interest or monopoly. Witness the recent fruitless efforts of the Eastern Counties people to obtain cheaper coal, by connecting their railway with the North, and their bill, thrown out almost unheard, against the convictions of every independent man. The only consolation for the sufferers is that knowledge and improvement will go on in spite of the petty impediments of prejudice and selfishness—"magna est veritas et prævalebit."